

# Application of submillimeter- and thermal-infrared measurements to retrieve ice cloud properties

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Ice clouds have a profound impact on the Earth's energy budget through their contribution to radiative warming, emission of infrared radiation, and cooling from reflection and absorption of solar short-wave radiation. These contributions, coupled with the variable structure and high spatial and temporal coverage of ice clouds, impose difficulties in quantifying their radiative characteristics, and thus limit our understanding of the current climate and potential future changes [1]. A principal difficulty in quantifying these radiative effects is the number of degrees of freedom affecting radiative forcing, such as ice water content and cloud microphysical properties [2]. To simplify calculations in general circulation models, many cloud properties are parameterized. Thus, to improve the representation of clouds in the models, a validation of these parameterizations with cloud property retrievals is essential. Successful retrievals of cloud properties from satellite based measurements is dependent on the ability to relate observed radiances to a unique set of desired cloud properties, and the most useful measurements are those that exhibit the greatest sensitivity to small perturbations in cloud microphysical properties. The potential of submillimeter radiometers has been recently explored to improve cirrus ice water content retrievals, and our previous results show good sensitivity for submillimeter and thermal infrared measurements to retrieve ice water content and particle diameter.

In this work we summarize these recent developments and present results of simulated retrievals of cirrus ice water path and particle effective diameter. We also discuss the inclusion of polarimetric measurements in these bands, and the possibility of retrieving cloud microphysical properties such as particle shape and size distributions.

## References

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- [2] Tang, G., Yang, P., and Wu, D. L., 2015: Sensitivity study of ice crystal optical properties in the 874 GHz submillimeter band. *J. Quant. Spectrosc. Radiat. Transfer* **187**, 416–421.

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